How To Share A Secret

based on an equally named paper by Adi Shamir
(the S in RSA)


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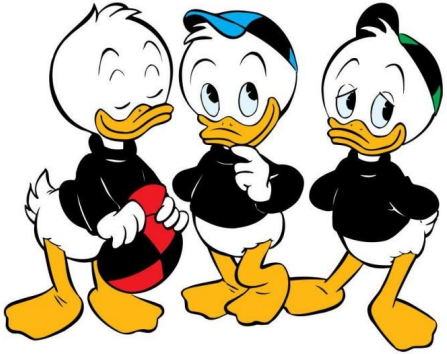
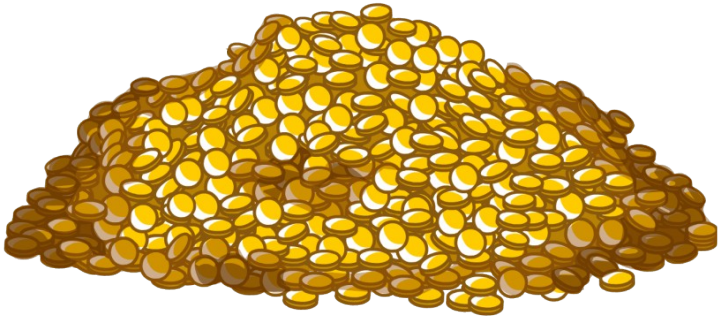
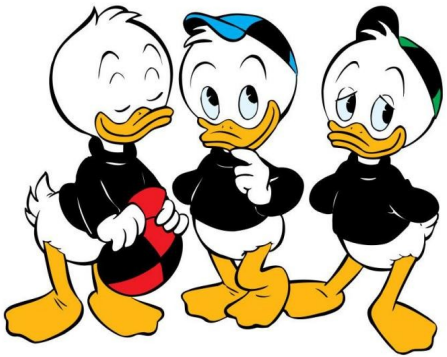
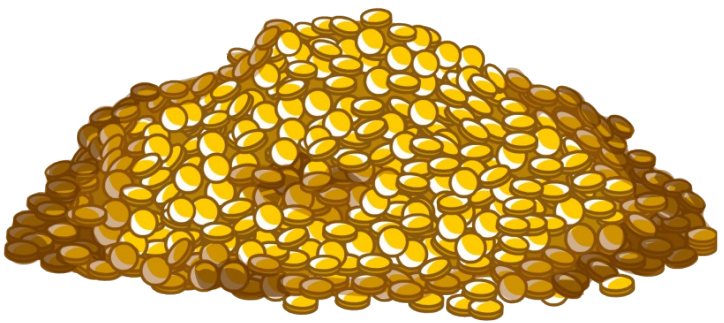
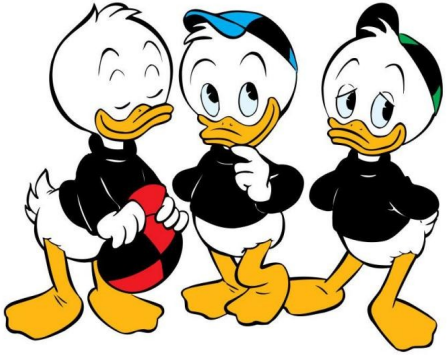


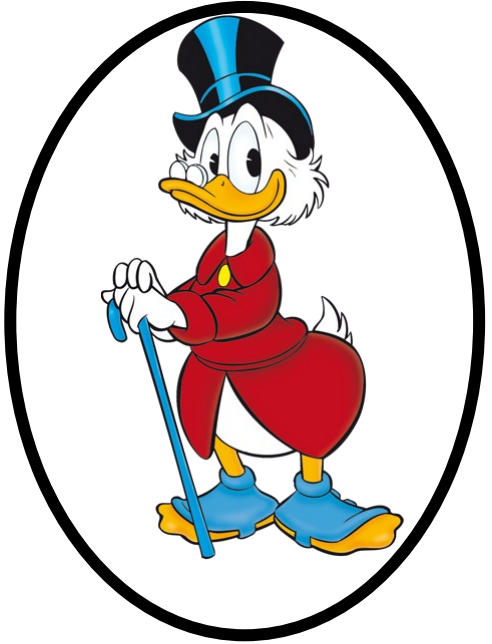


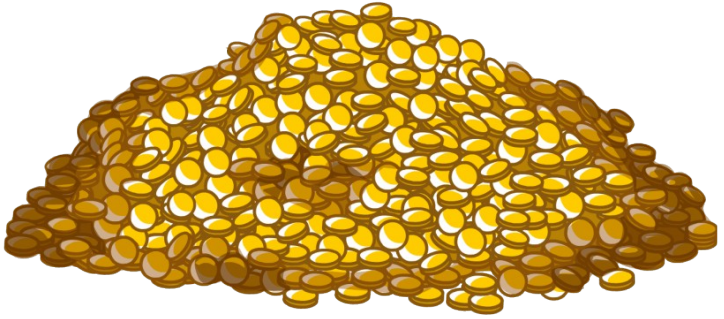


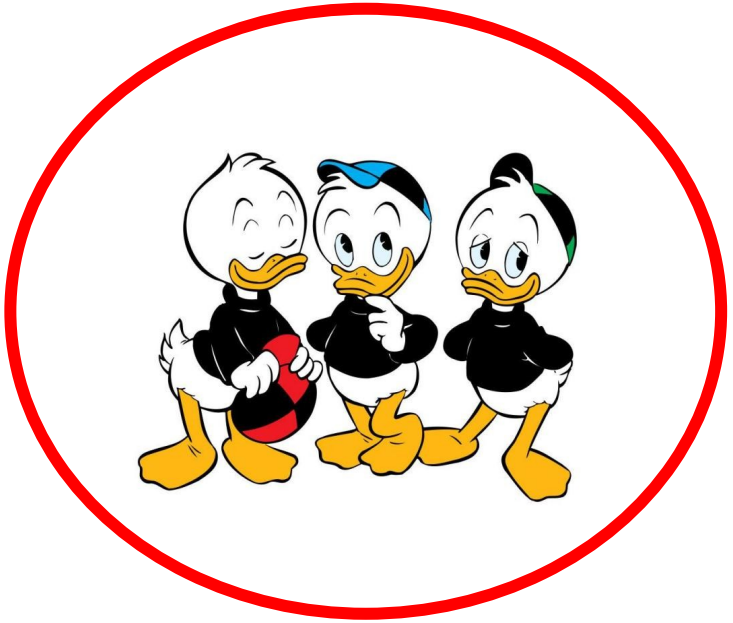


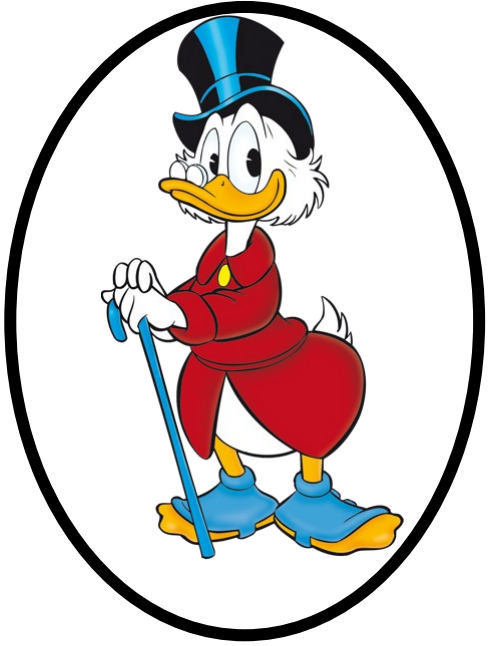
Everyone Gets Access Keys

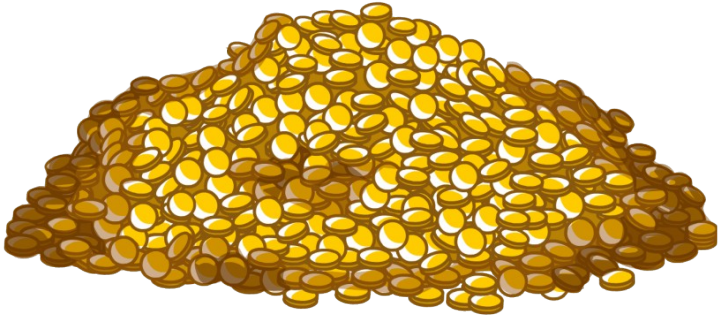


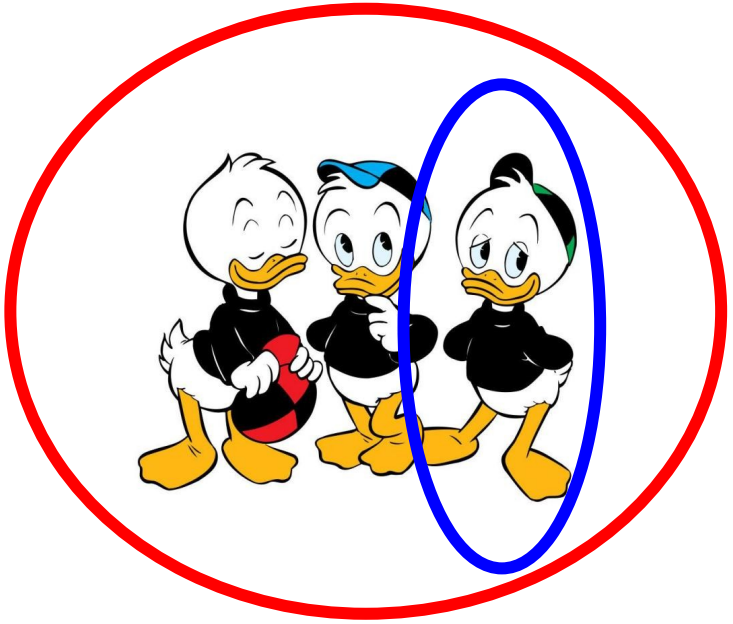


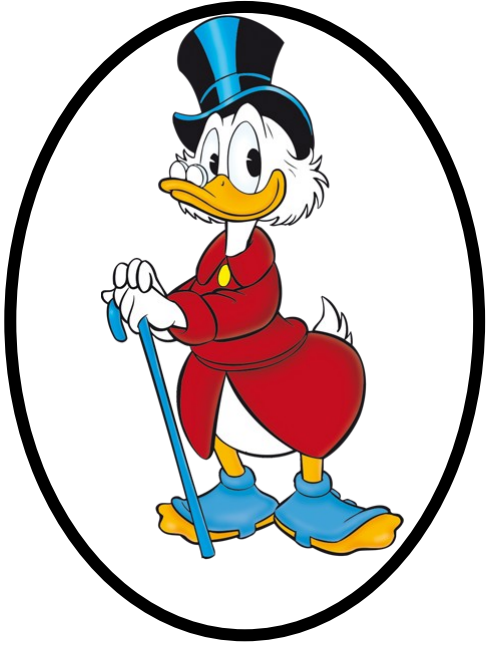


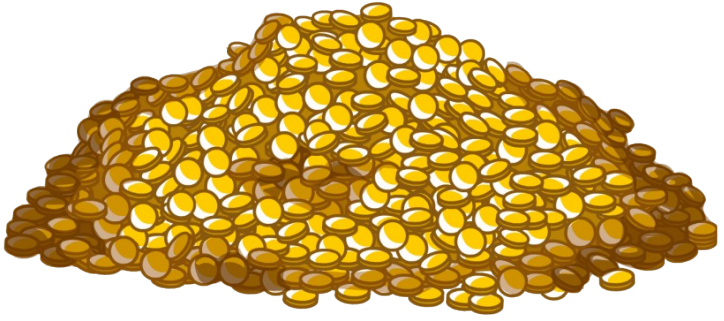


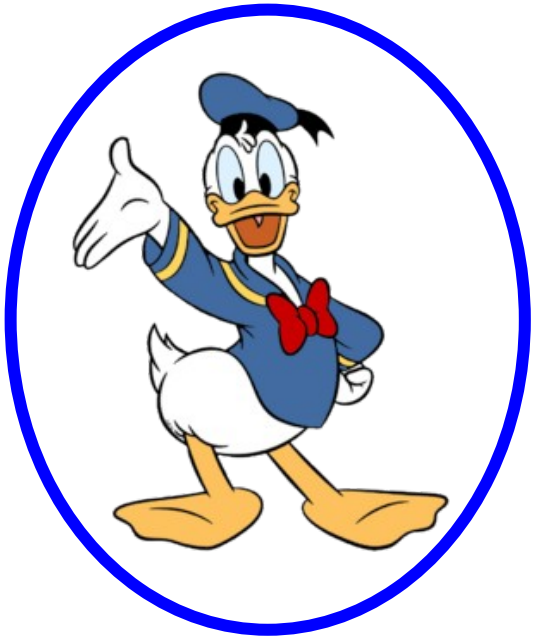


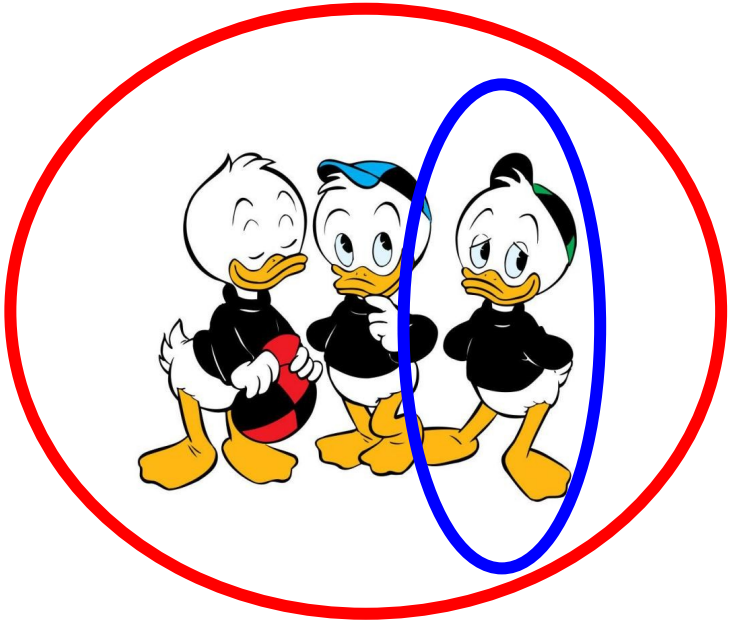


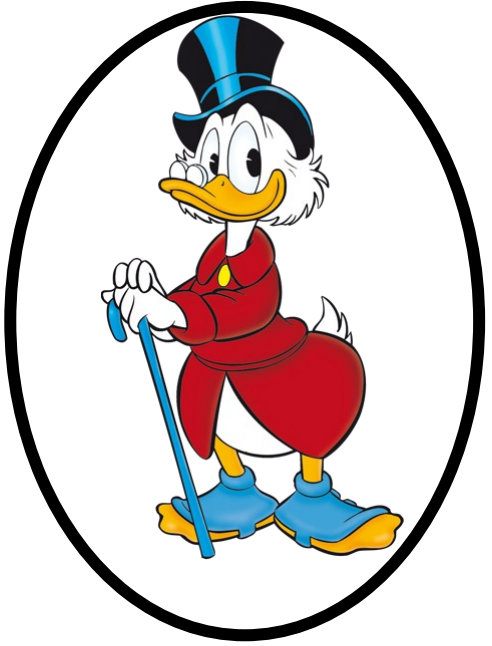


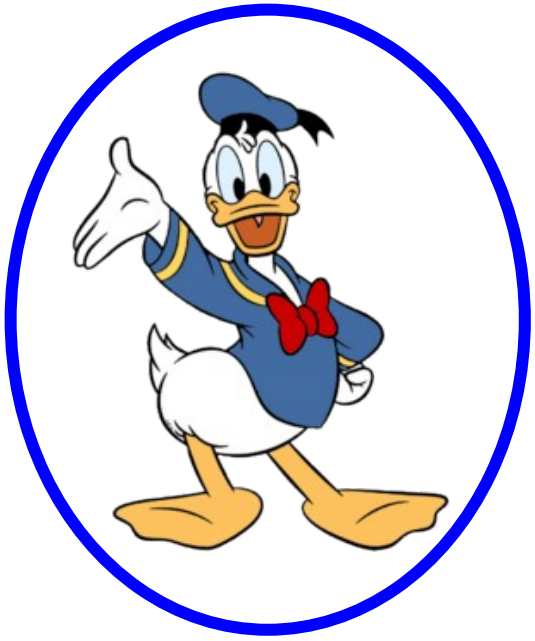


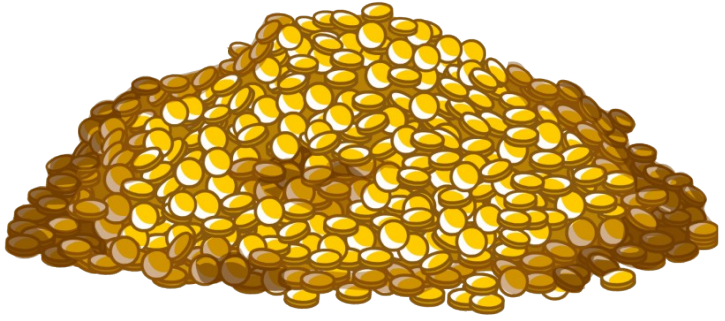




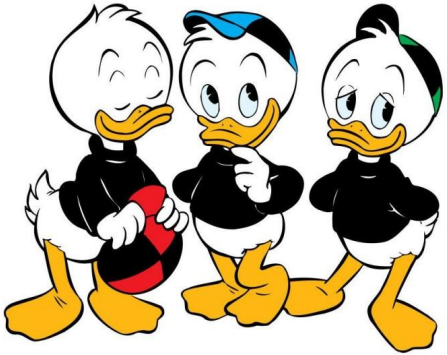








Hierarchical Access

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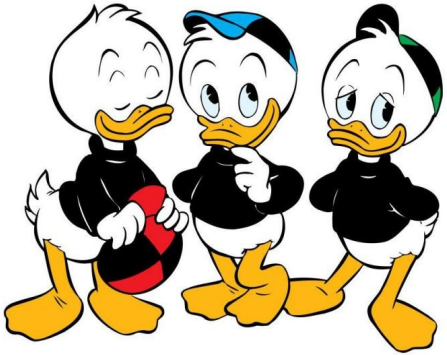


Security Against Theft

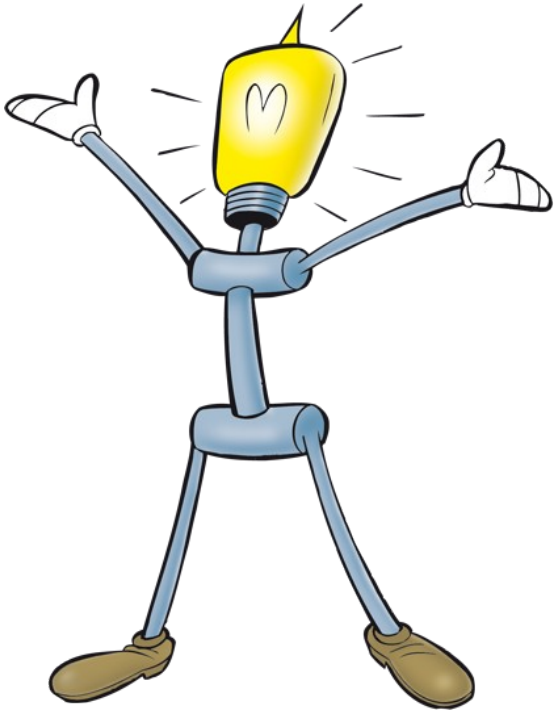
How?

One hidden master key for all?

How?

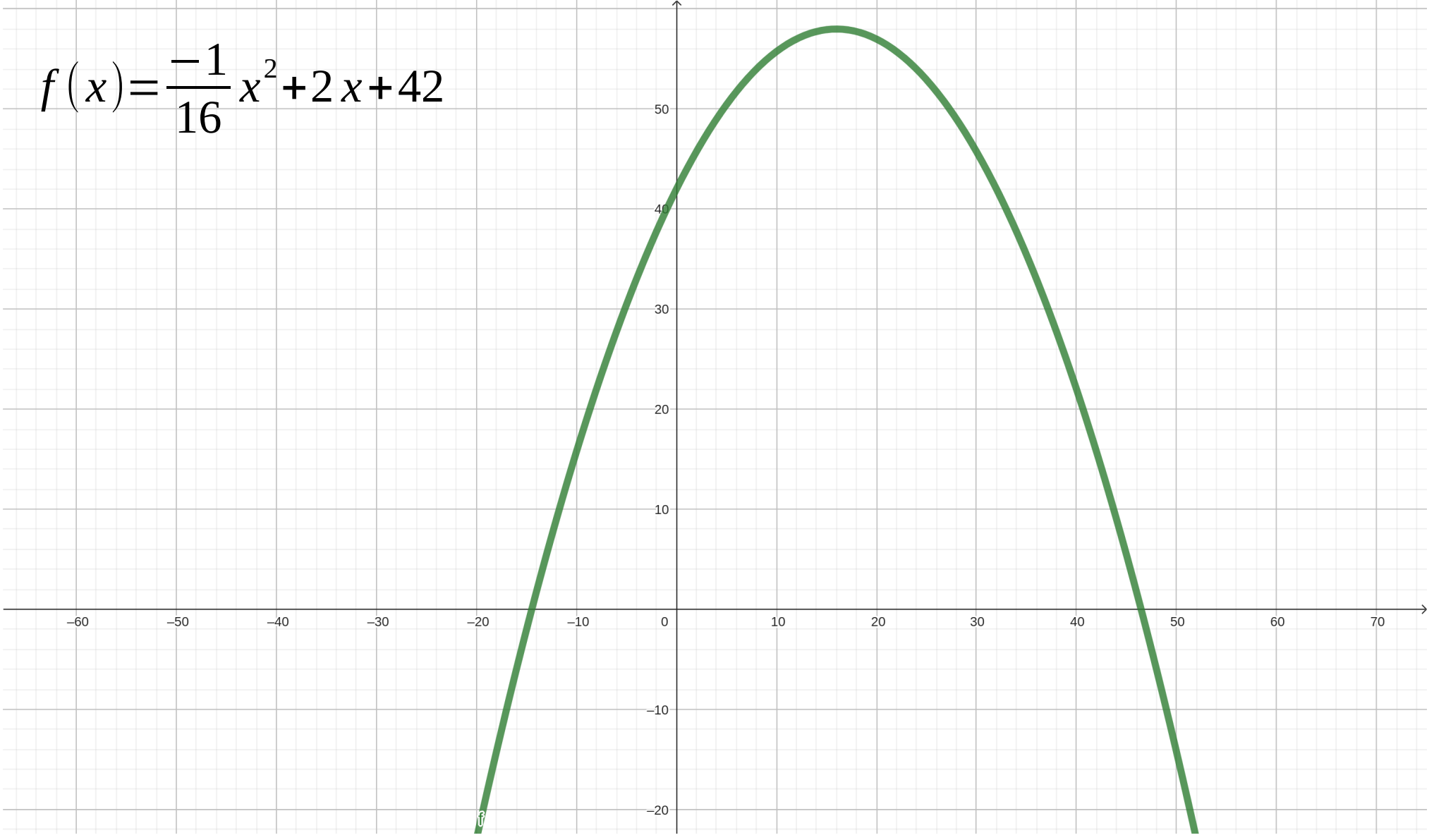
One hidden master key for all?
No hierarchy!
No security against theft or loss!

How?



Use a **polynomial** (and a master key)**!**

$$f(x)=\frac{-1}{16}x^2+2x+42$$



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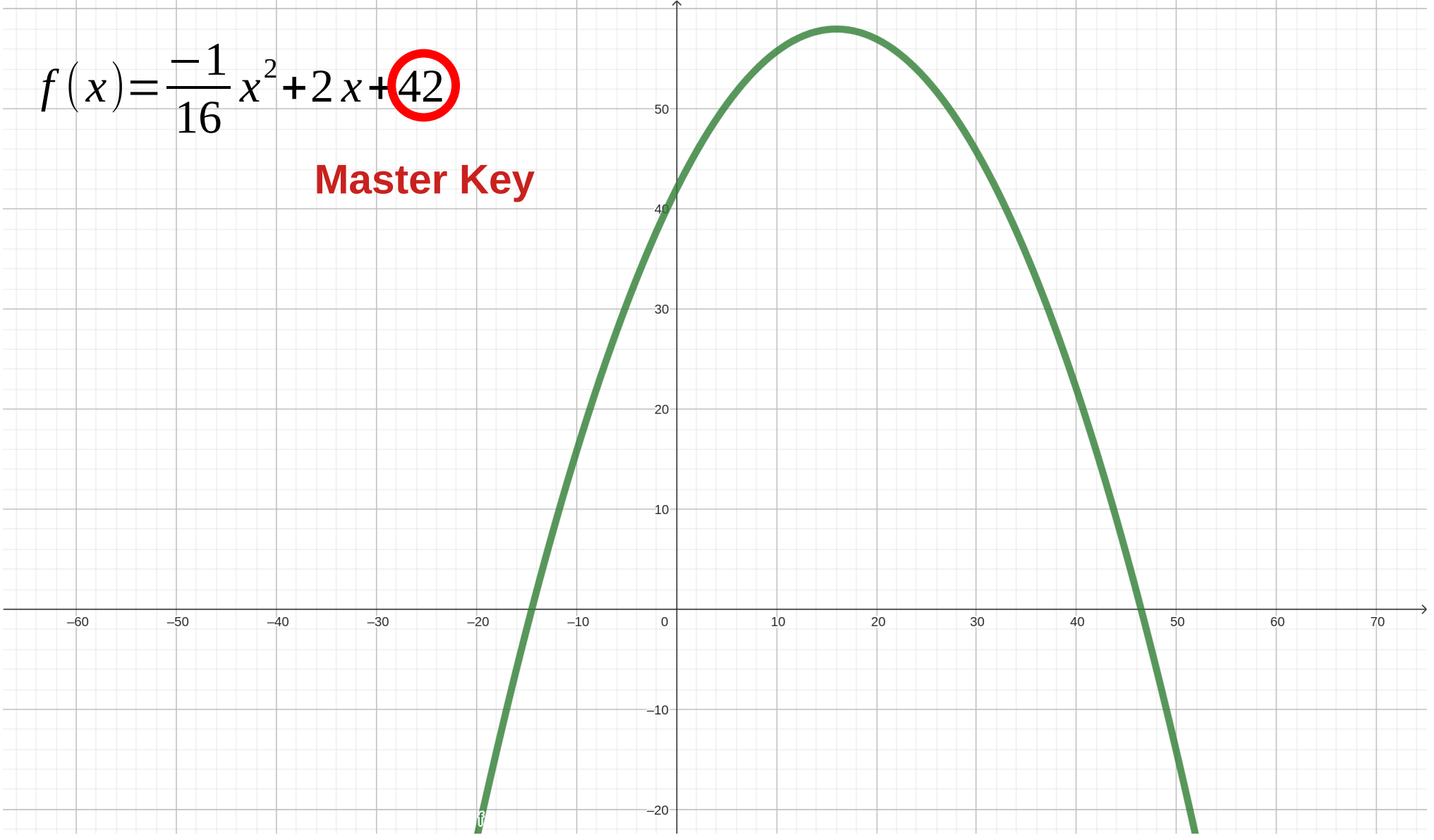
Master Key



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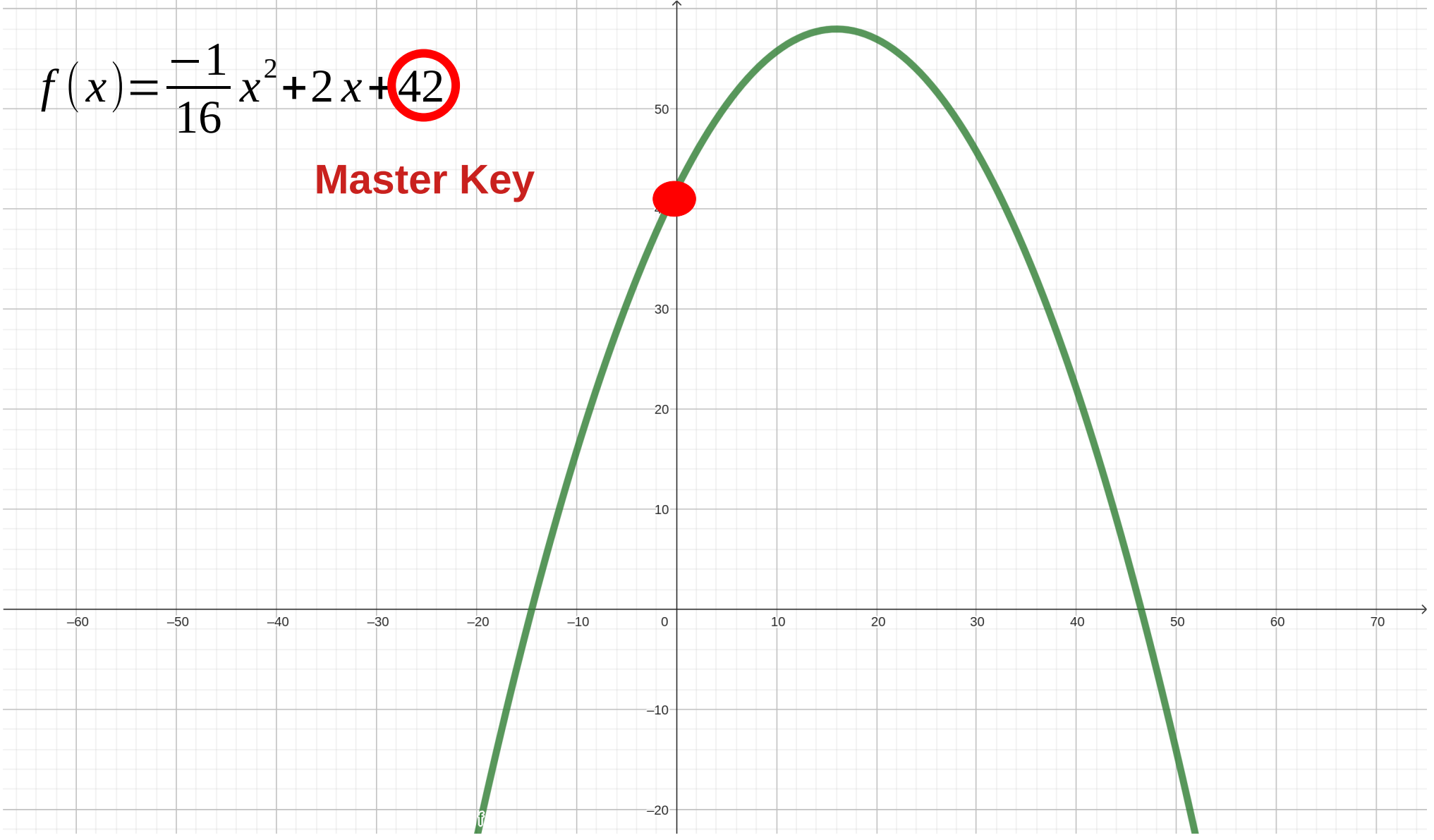

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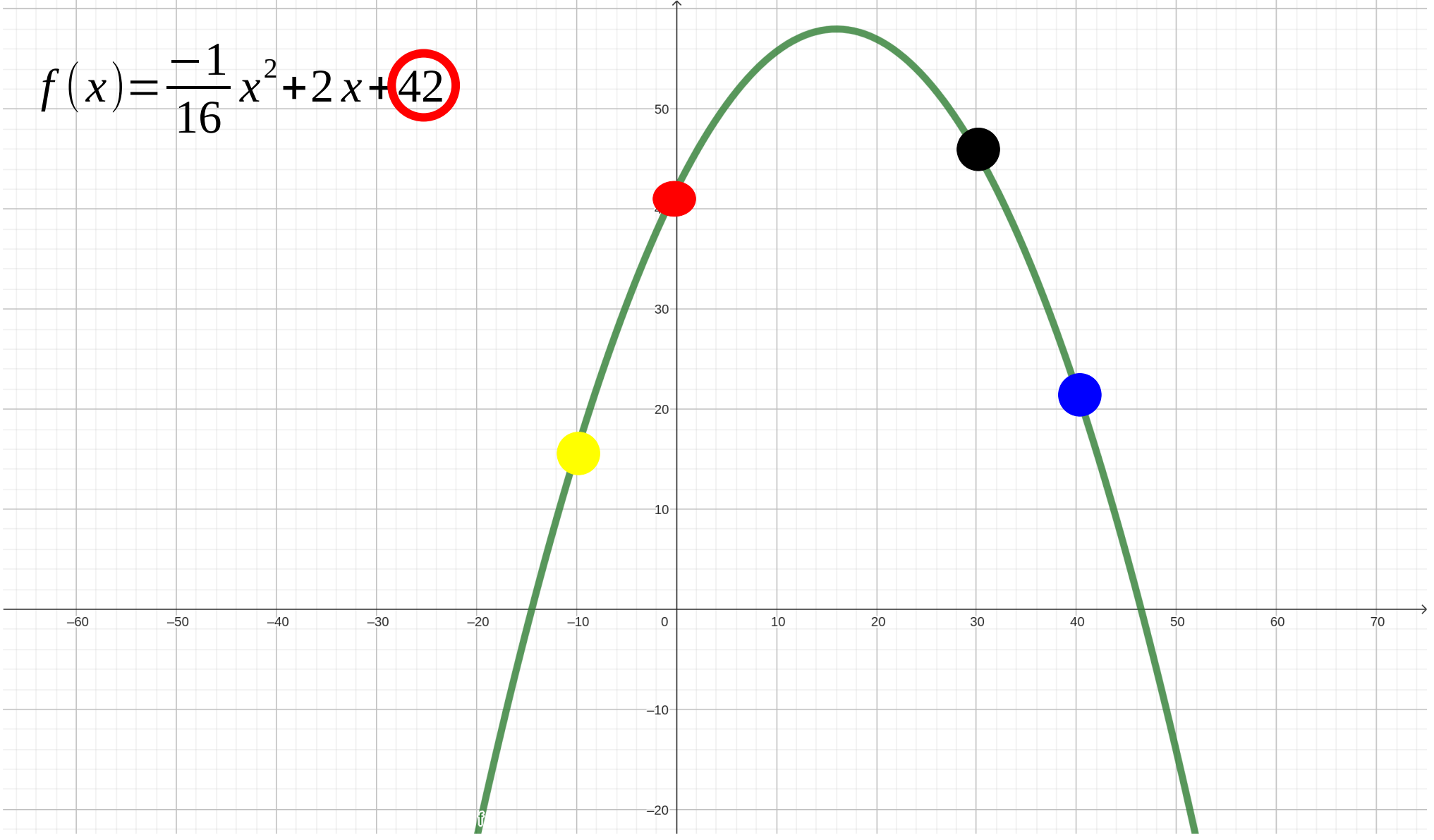

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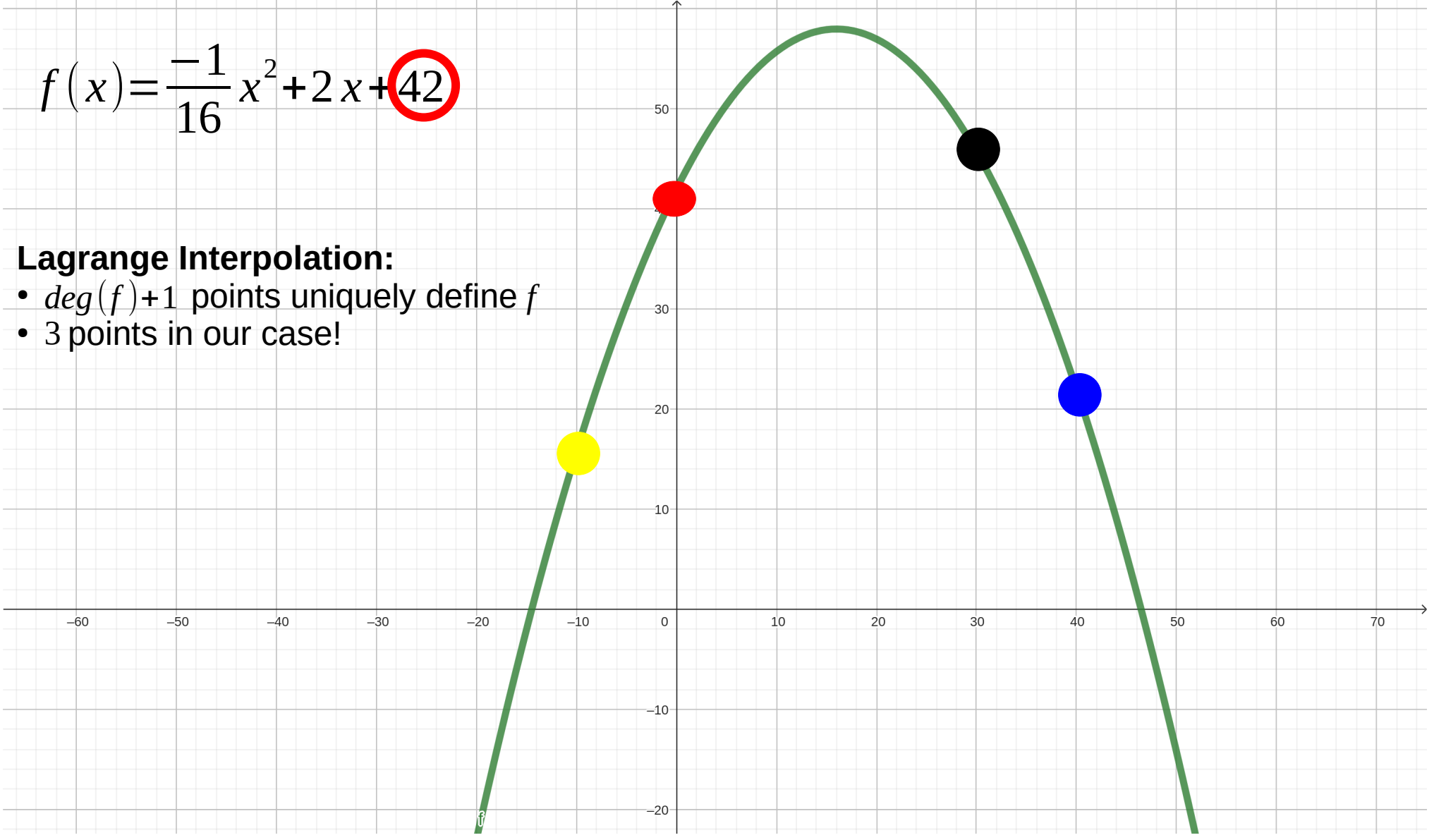
Lagrange Interpolation:

- $deg(f)+1$ points uniquely define f
- 3 points in our case!



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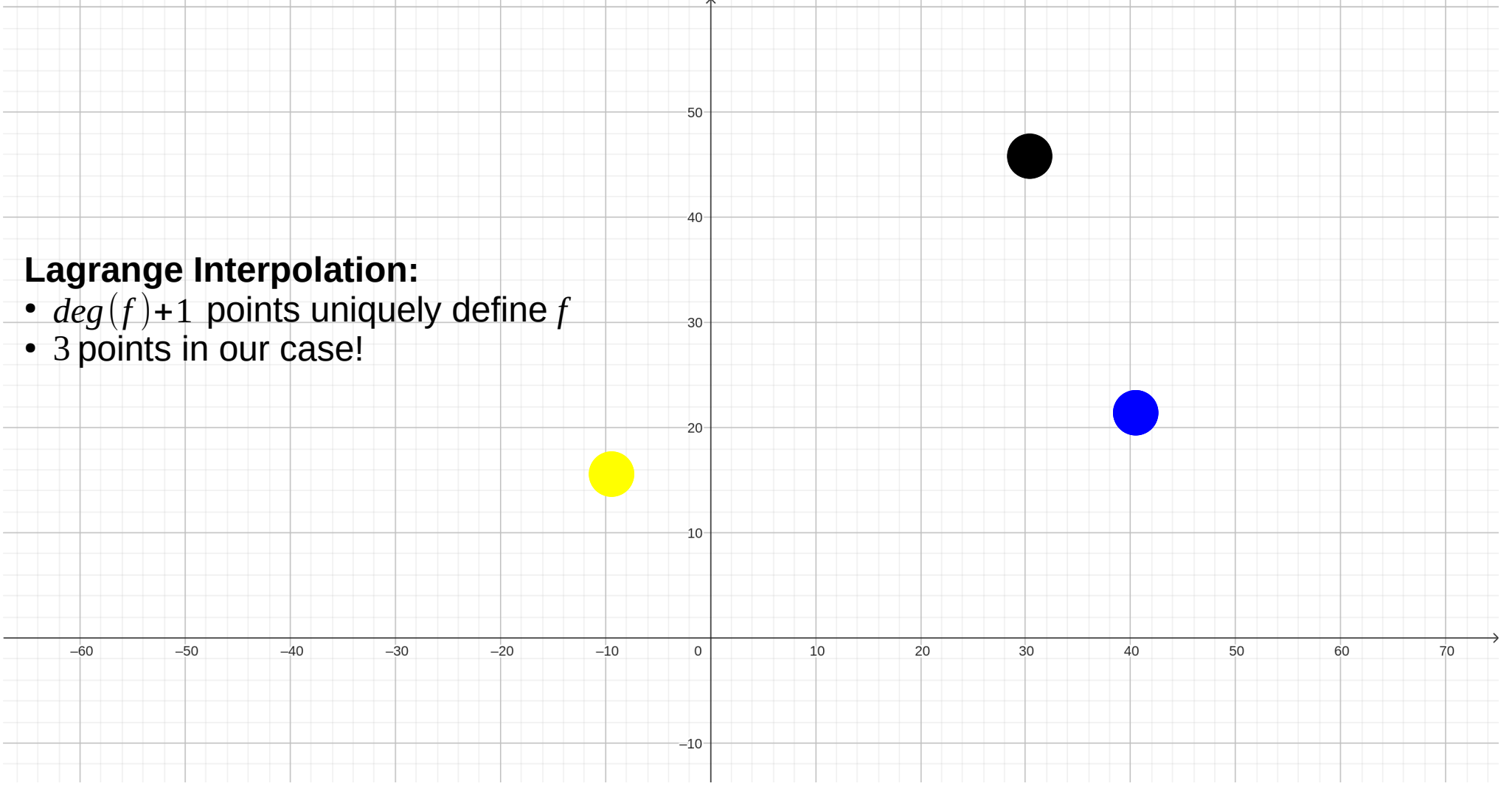

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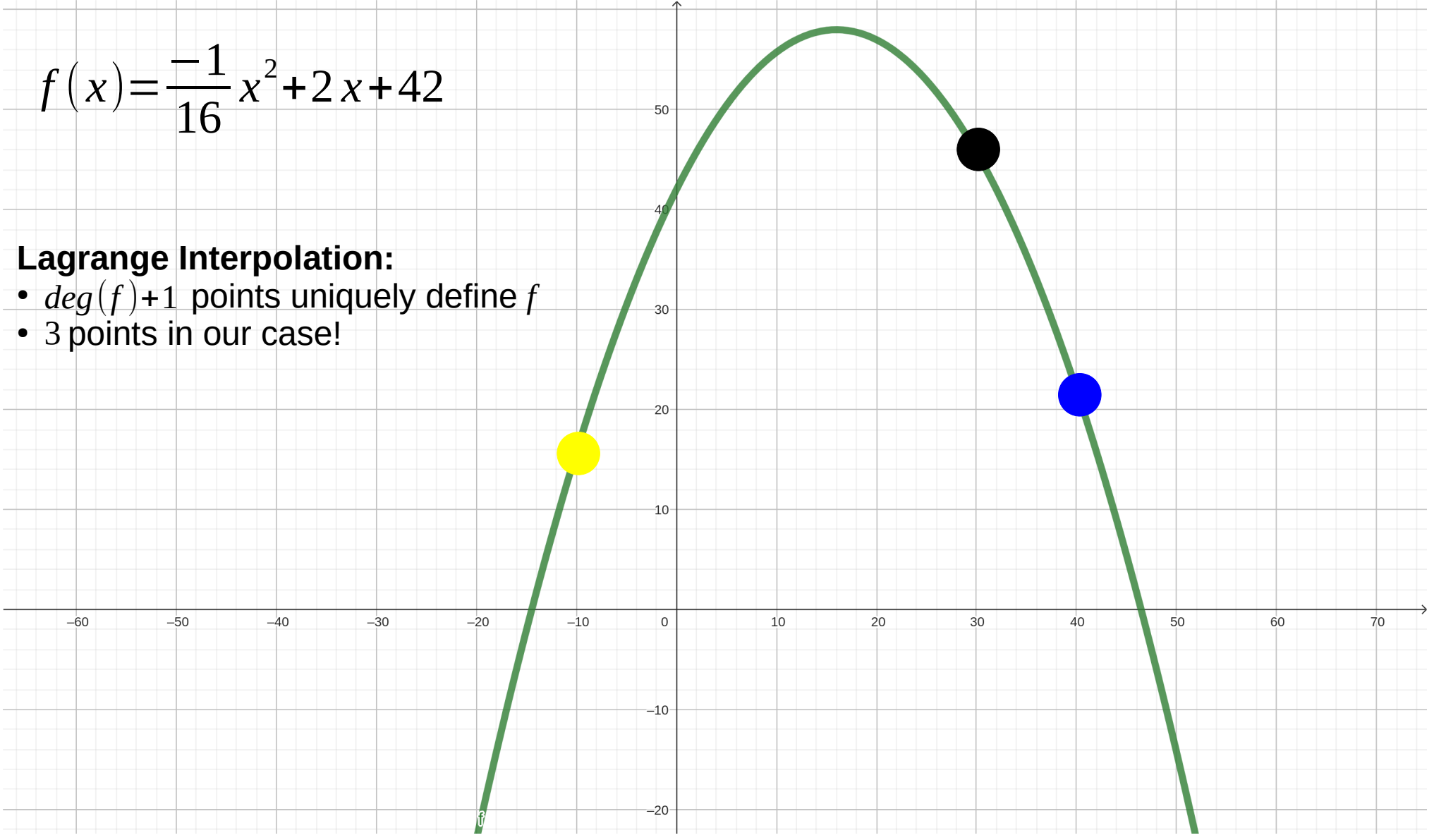

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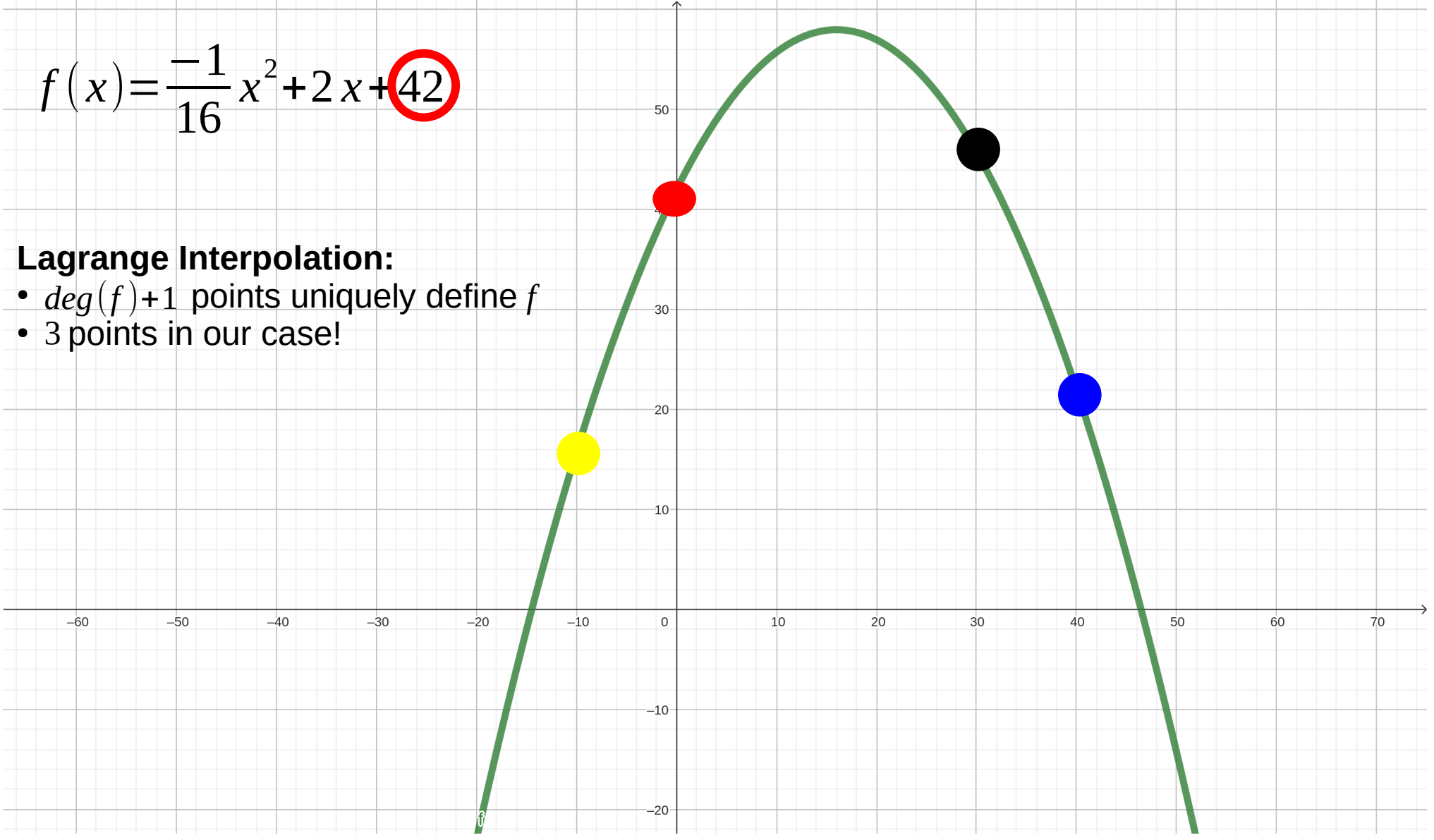

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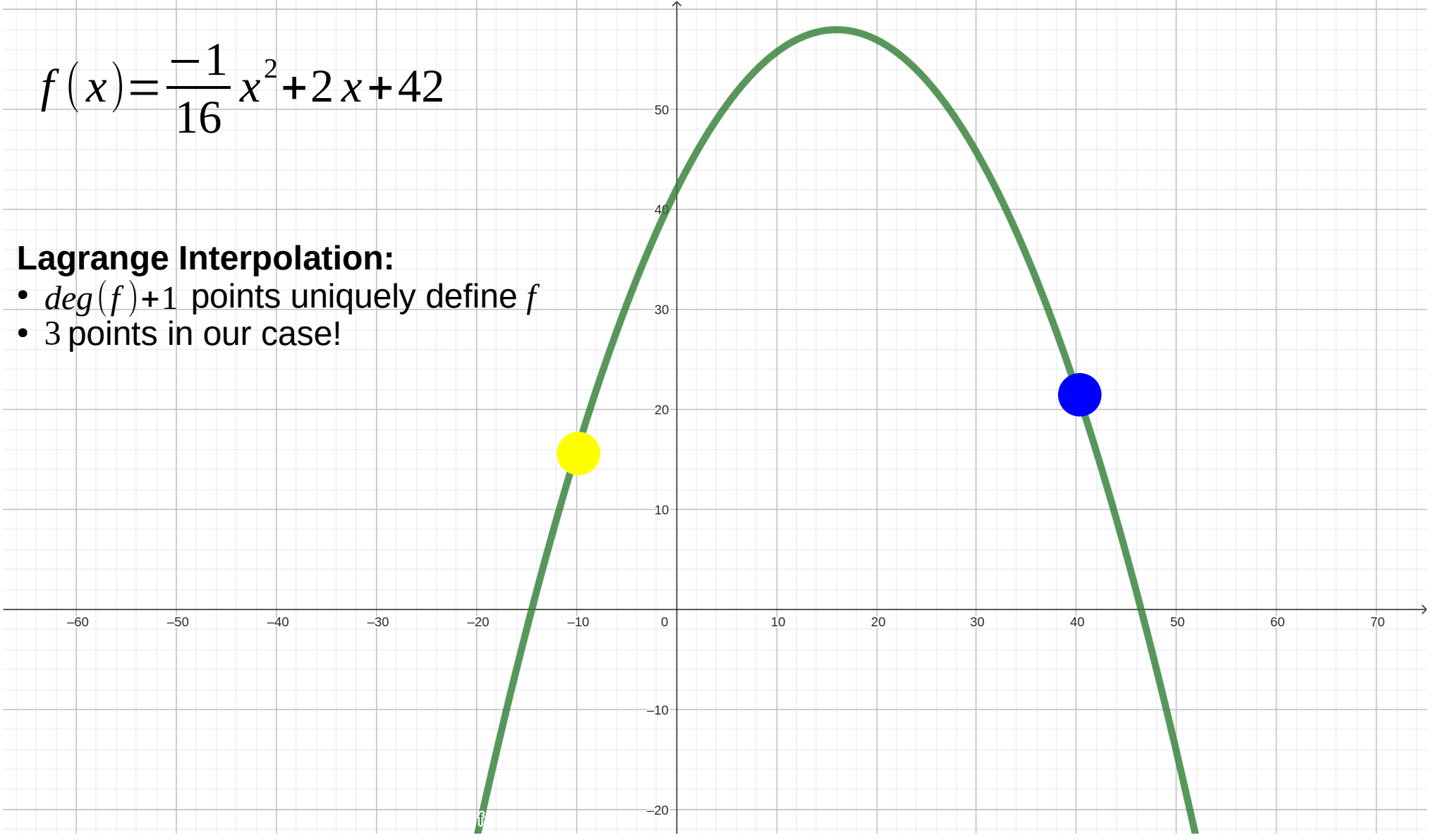

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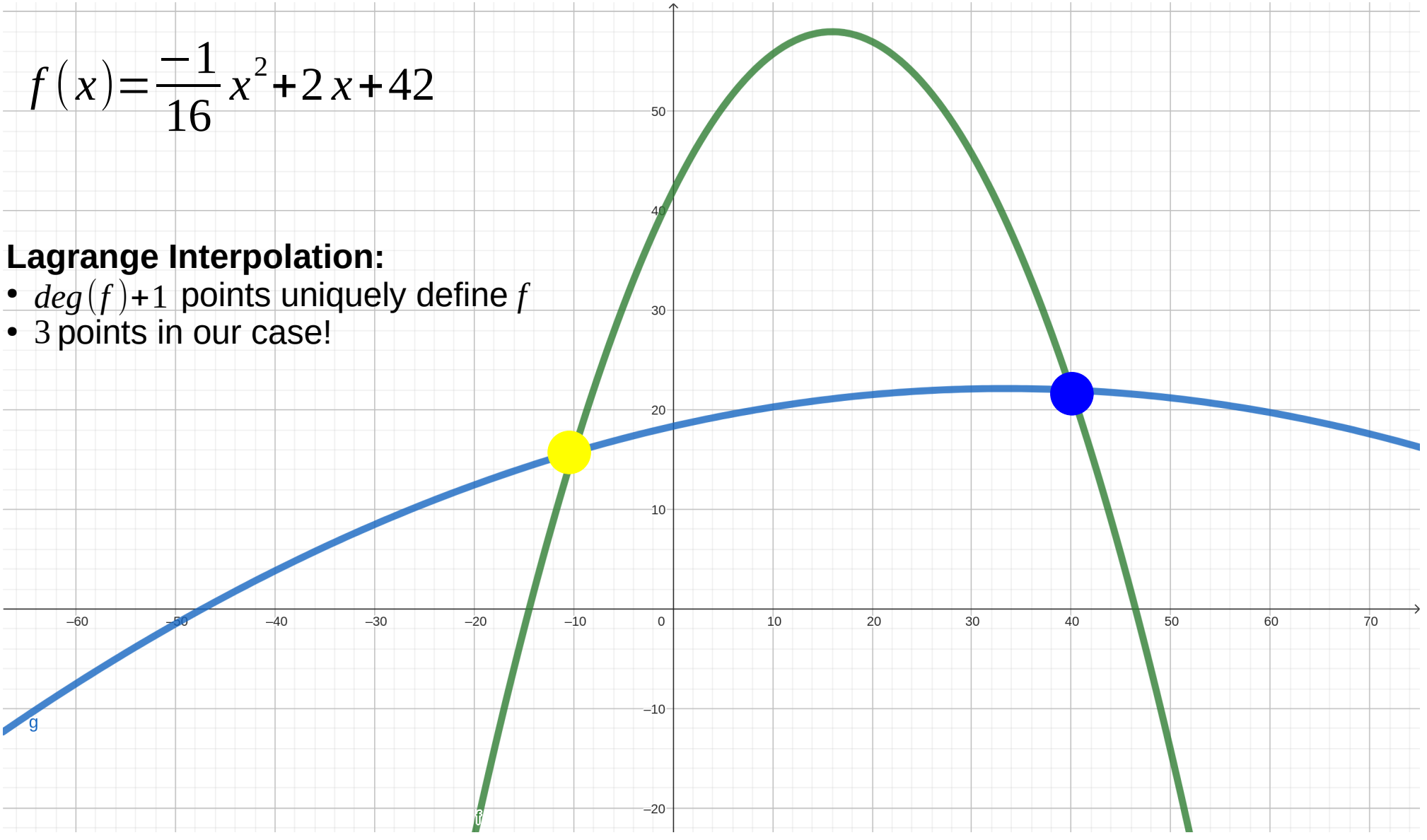

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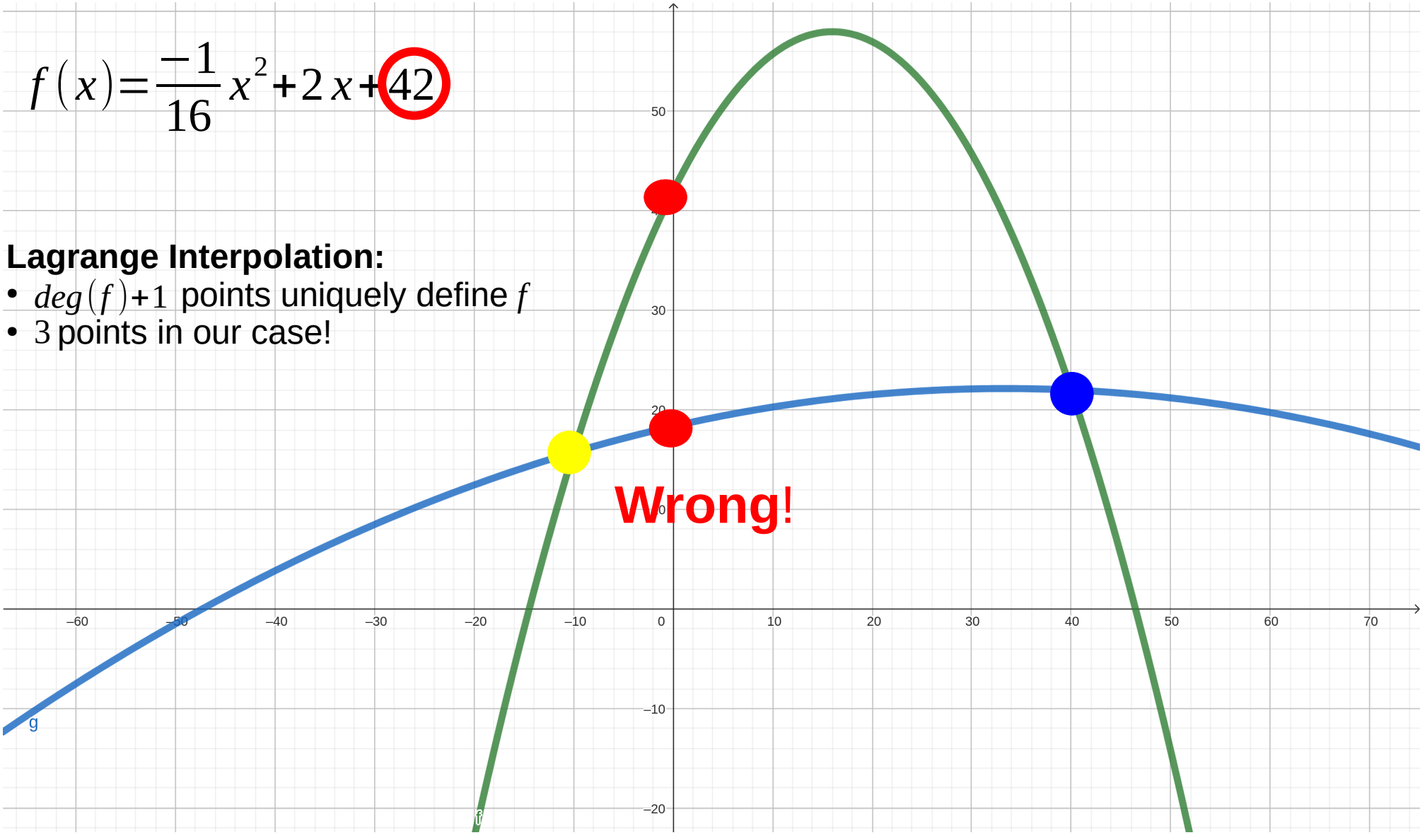

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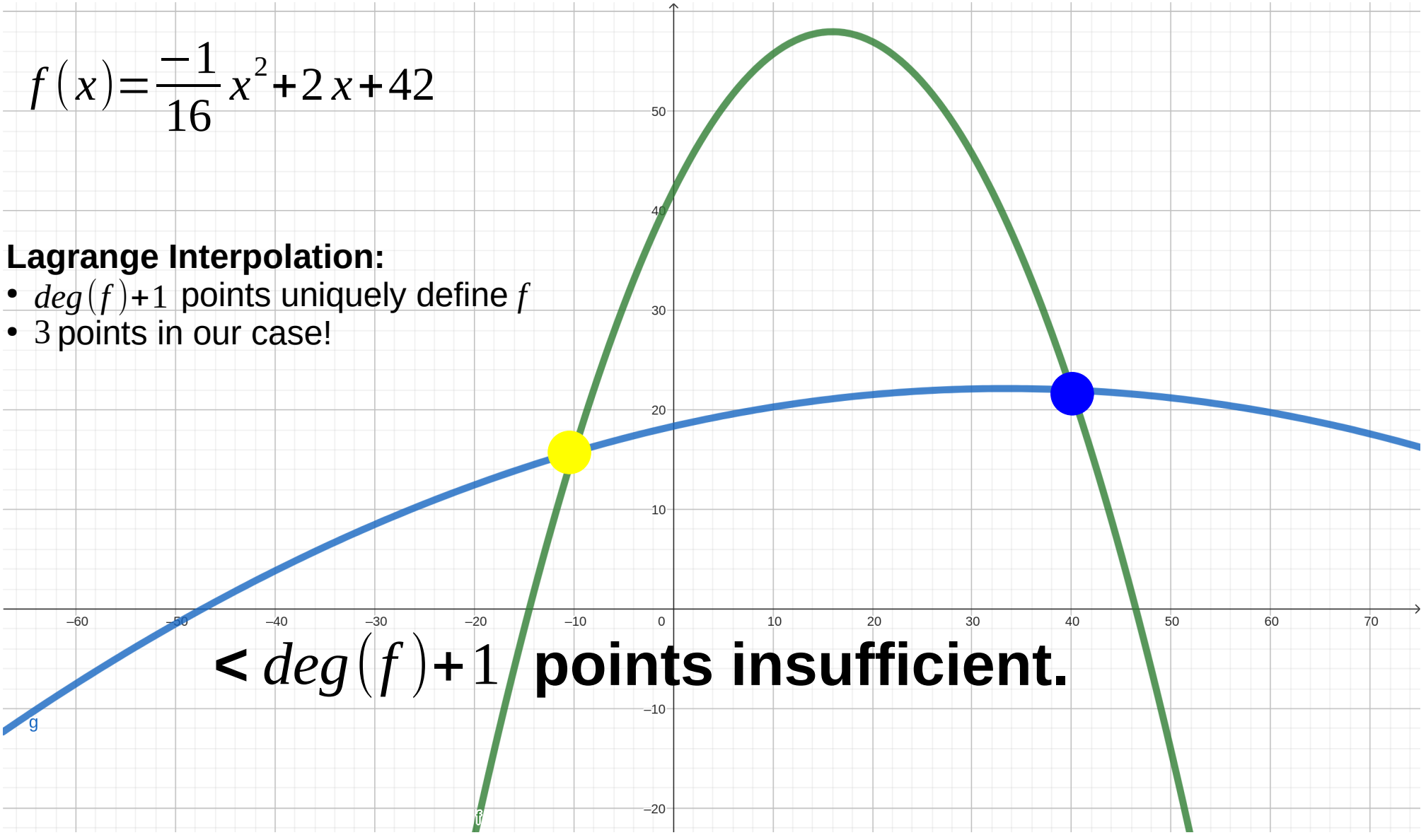

$< deg(f)+1$ points insufficient.

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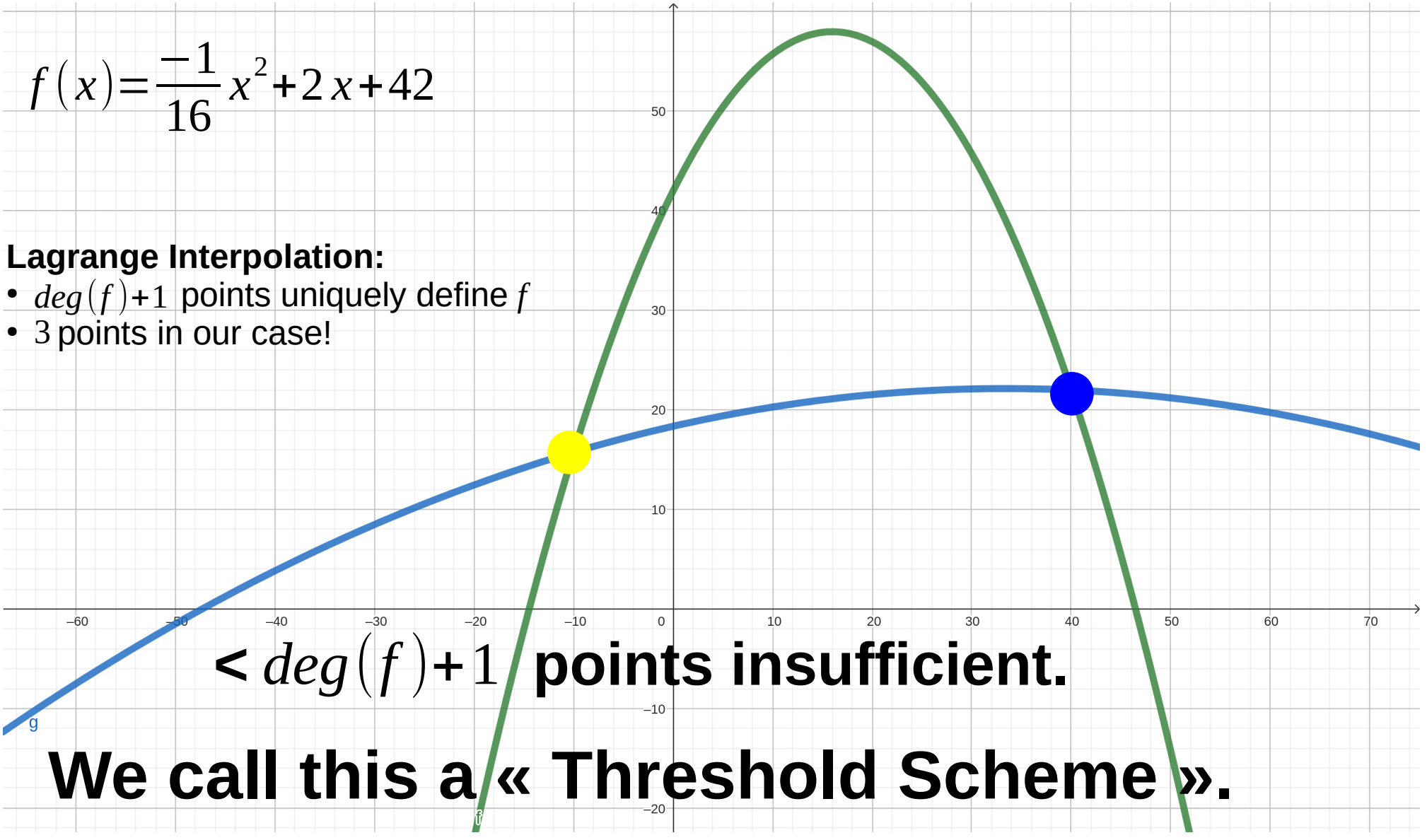
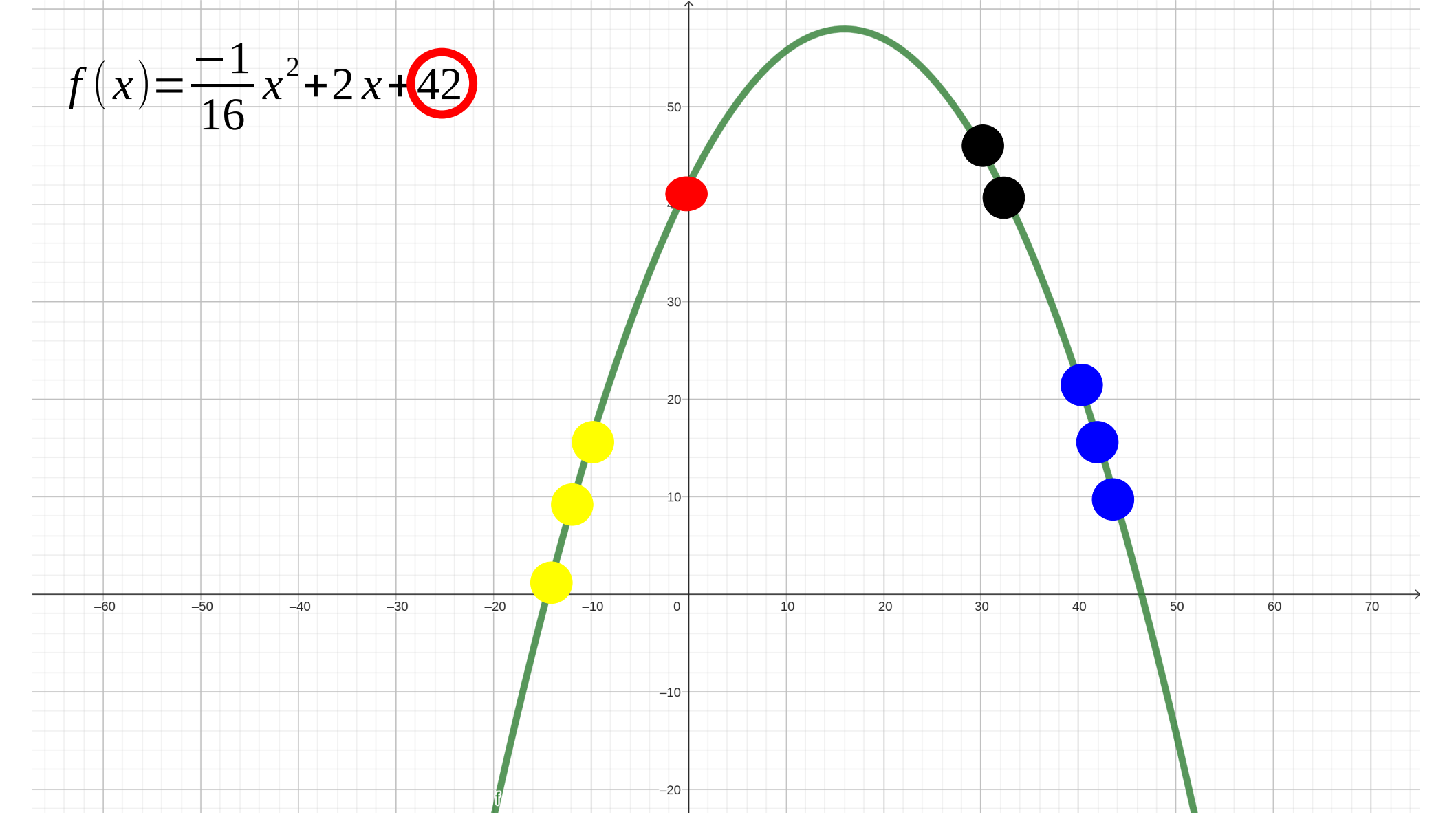


$< deg(f)+1$ points insufficient.

We call this a « Threshold Scheme ».


$f(x)=\frac{-1}{16}x^2+2x+42$
50
30
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−40
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−10
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10
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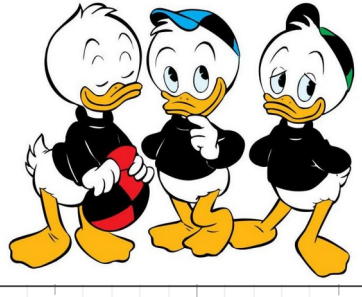
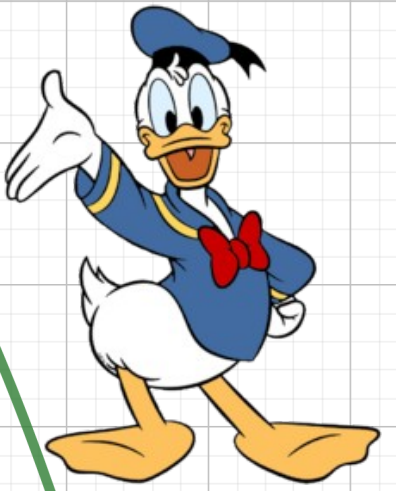
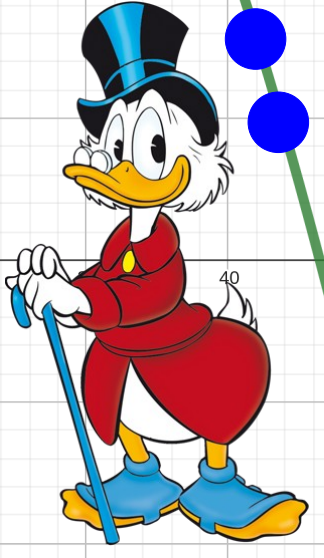
40
50
60
70

$$f(x)=\frac{-1}{16}x^2+2x+42$$







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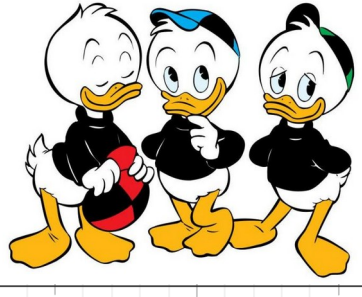
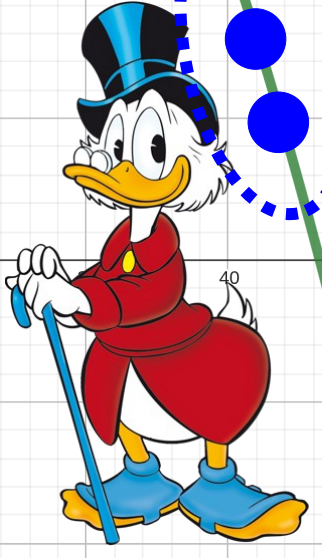
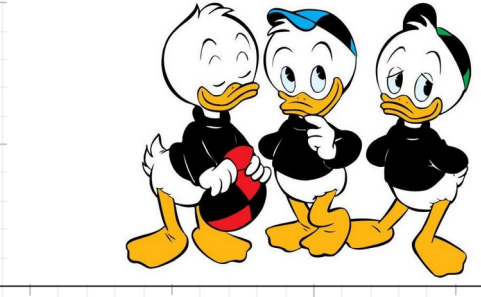
1. Hierarchical Access

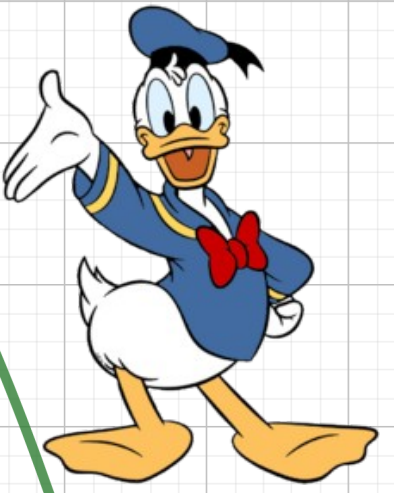


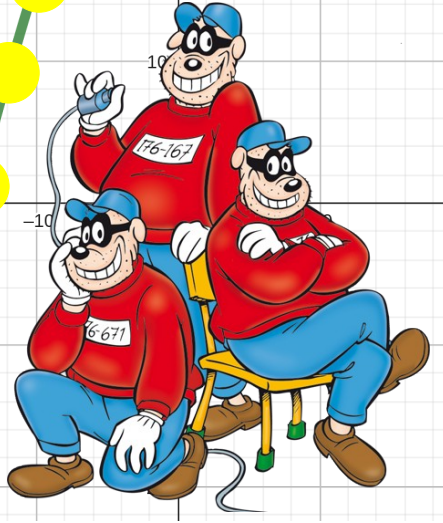


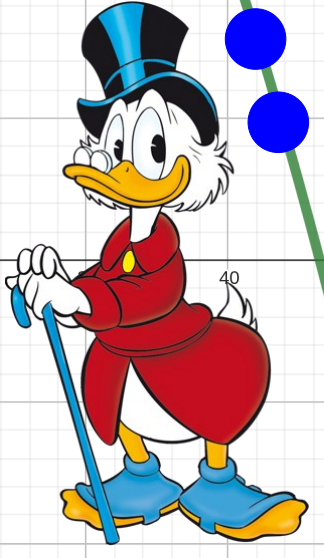
$$f(x)=\frac{-1}{16}x^2+2x+42$$

1. Hierarchical Access
2. Security Against Theft









How to Share a Secret:
Threshold Schemes!

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Used in Secure Multi-Party Computation

Notable Use Case: Cryptocurrencies

Sources

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$$f(x)=\frac{-1}{16}x^2+2x+42$$